The Road Not Taken

Michigan's Highway Funding Decisions:
Lessons from the Past and Implications for the Future

Gordon Proctor & Associates
StarIsis Corp. and
Spy Pond Partners, LLC

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Executive Summary

In 1997, the Michigan Legislature increased the fuel tax by four cents per gallon to improve the state's highway network, which at that time had some of the roughest pavements and most structurally deficient bridges in the country. Now, the Legislature is again considering additional highway investment.

This report examines the uses of the 1997 four-cent fuel tax increase and whether it was adequate to sustain highway conditions today and into the future.

This report reaches several key findings including:

- The 1997 four-cent per gallon increase was inadequate to achieve the state highway bridge and pavement condition targets set by the state transportation commission and also pay for the system-expansion projects pursued by the state between 1997 and 2003.

- Because its revenue was inadequate, the Michigan Department of Transportation (MDOT) relied on extensive borrowing and the use of one-time federal economic stimulus funds to augment its bridge and pavement budgets.

- That borrowing allowed MDOT to improve pavement and bridge conditions substantially from near-worst conditions nationally in 1997. By 2007, the department provided motorists much smoother pavements and stronger bridges.

- However, this borrowing just to preserve pavements and bridges over the 15 year period left MDOT with a significant debt that cost it in 2012 nearly $103 million in principal and interest. Total annual debt payments for all bonds, including those for system-expansion projects and those issued prior to 1997, are about $220 million annually. MDOT's debt load is near its limit and leaves the department unable to undertake substantial additional borrowing.

- With less borrowing, bridge and pavement budgets are declining. Construction prices have risen substantially since 1997, greatly reducing purchasing power. When adjusted for inflation, the projected MDOT pavement budget for 2015 will be smaller than it was in 1997.

- If additional investment is not forthcoming, the Michigan trunkline pavements will return to the poor conditions of 1997, and the gain in bridge conditions will begin to reverse. Pavement modeling indicates that by 2018, more than half of the MDOT trunkline miles will have poor pavement conditions. Bridge forecasts are not as dire, but MDOT bridges are predicted to fall in 10 years below the national mandated condition targets of no more than 10 percent of the bridge deck area on the National Highway System being structurally deficient. These declines are expected to occur despite MDOT adopting some of the most advanced infrastructure-preservation practices in the country.

- The analysis concludes that instead of a four-cent increase in 1997, a nine cent per gallon increase would have enabled the department to meet the 2007 condition goals without borrowing. A 14 cent per gallon increase would have been needed for MDOT to meet its bridge and pavement condition targets and sustain them to 2012.

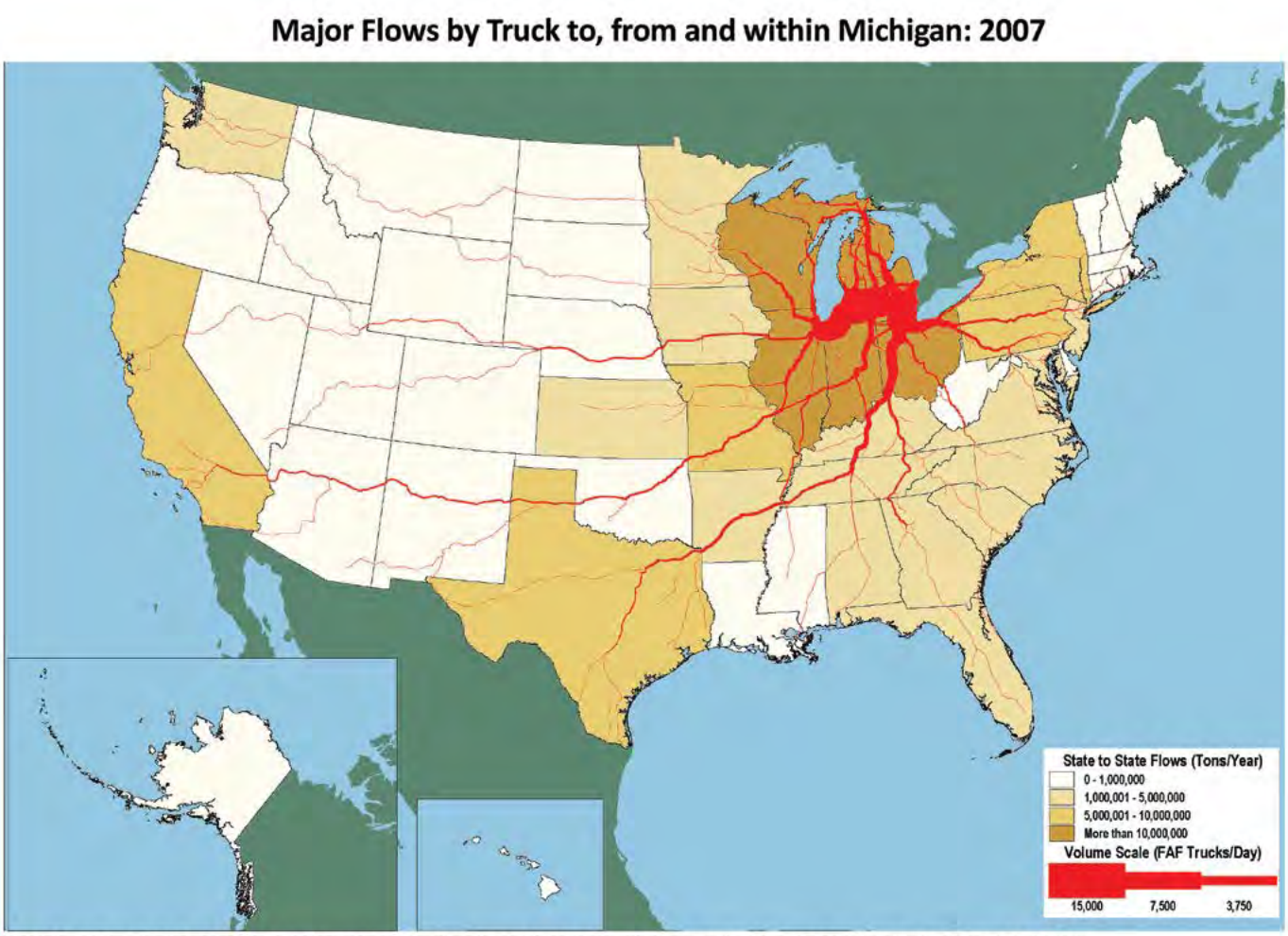
- The analysis holds significant lessons for today. Without substantial new investment, the Michigan state highway conditions will degrade rapidly and many of the gains of the past 16 years will be lost. The modest increase of 1997 was not nearly adequate to cover the costs of both system preservation and system expansion. The amount of debt incurred in the past decade creates a costly burden that today diminishes the amount of revenue that can be devoted to sustaining basic highway conditions. Additional borrowing and federal bailouts are unlikely to provide simple solutions.

- As investment decisions are made in 2013, it is clear that substantial new revenue for the preservation of Michigan's basic highway

conditions is needed. It also is clear that another modest increase such as 1997's will have only limited impact. To ensure that Michigan has a highway network that is sustainable for the long term will require a substantial investment significantly greater than in 1997. Otherwise, Michigan will be on a path to return to the pot-holed pavements and load-limited bridges of the 1990s.

Background: Michigan's Critical Highway Network

The Michigan trunkline serves as the backbone for the state's economy and carries the majority of the state's passenger travel. Although MDOT is responsible for only 7.9 percent of the state's centerline miles, those miles include the state's Interstate Highway System and National Highway System that nationally carry more than 75 percent of the nation's heavy truck volumes. In Michigan, the state trunkline system carries 51 percent of all traffic and 65 percent of commercial truck traffic. The Federal Highway Administration estimates that in 2011 nearly $950 billion worth of freight moved within, out of or into Michigan with 72 percent by value moving by truck.[1] As seen in Figure 1, the Michigan trunkline links to a national and global freight system that is essential



Note: Major flows include domestic and international freight moving by truck on highway segments with more than twenty five FAF trucks per day and between places typically more than fifty miles apart.
Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework, version 3.1.2, 2011.

Figure 1. *FHWA flow map of Michigan freight movements.*

to the state's economy. The red tendrils to Windsor, Ontario, New York City and southern California represent global imports and exports that comprise a substantial portion of the state and national economy.

MDOT is responsible for 9,651 centerline miles of trunklines and 4,683 bridges. It owns 41 percent of the state's bridges but those include nearly all of the large structures that give MDOT responsibility for 75 percent of the total state bridge deck area. Although MDOT owns a minority of the bridges, it faces a large majority of the total costs to maintain bridges in the state.

Michigan's economy is particularly transport dependent. The Bureau of Labor Statistics reports that 41 percent of the state's jobs depend upon three travel-dependent sectors: manufacturing; trade, transportation and utilities; and tourism.[2] Figure 2 shows the value of truck exports through Michigan and it illustrates how much the trunklines and the national economy are closely related. As the economy grows, travel upon the highway network increases. Conversely, how the highway network performs can influence how attractive the state is for companies engaged in travel-related sectors.

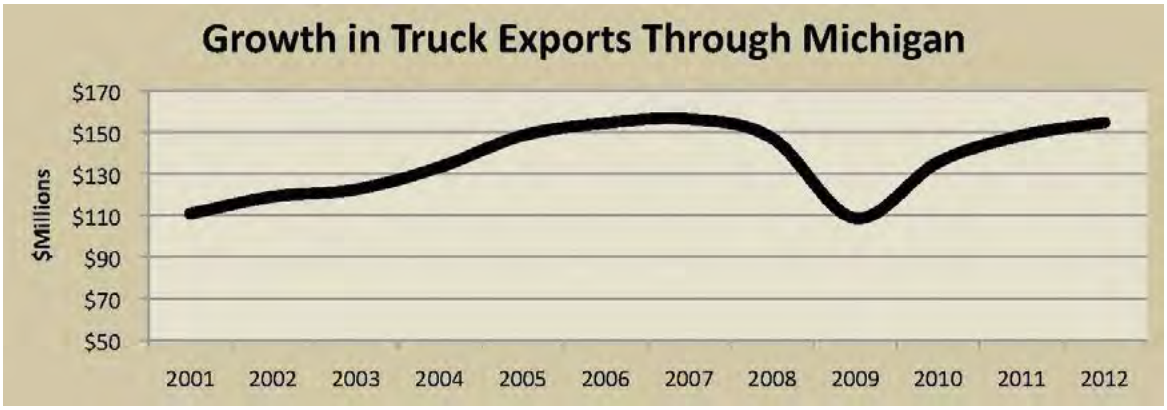


Figure 2. *Michigan's economy is transportation dependent.*

Michigan 1997: A Highway Network in Decline

In 1997, Michigan had among the worst highway conditions in the country. As seen in figure 3 (see next page), the Michigan bridges on the National Highway System (NHS) were rated 49th out of the 50 states in terms of the proportion of bridges structurally deficient. A structurally deficient bridge is not in danger of collapse but may require significant repair to remain safe and serviceable. In 1997, 26.3 percent of Michigan's NHS bridges by area were structurally deficient, which was well over two-and-one-half times the national average. Compared to peer states, the Michigan DOT NHS bridge structural deficiencies were twice as great as Ohio's and more than eight times greater than Indiana's.

The National Highway System bridges are cited here because the NHS is the most important component of the U.S. highway system in terms of total traffic volume and economic activity. The NHS is approximately 4 percent of the public road miles but it includes the major routes such as the Interstate Highway System and critical arterials such as US 23, 127, 131, 10, 46, 28 and 2. Nationally, and proportionally in most states, the NHS is only 4 percent of the public road mileage but carries nearly 40 percent of all traffic[3] Even more important from an economic standpoint, the NHS carries 75 percent of heavy truck traffic, and 90 percent of tourist traffic.[4] These freeways and arterials are disproportionately important, and in Michigan,

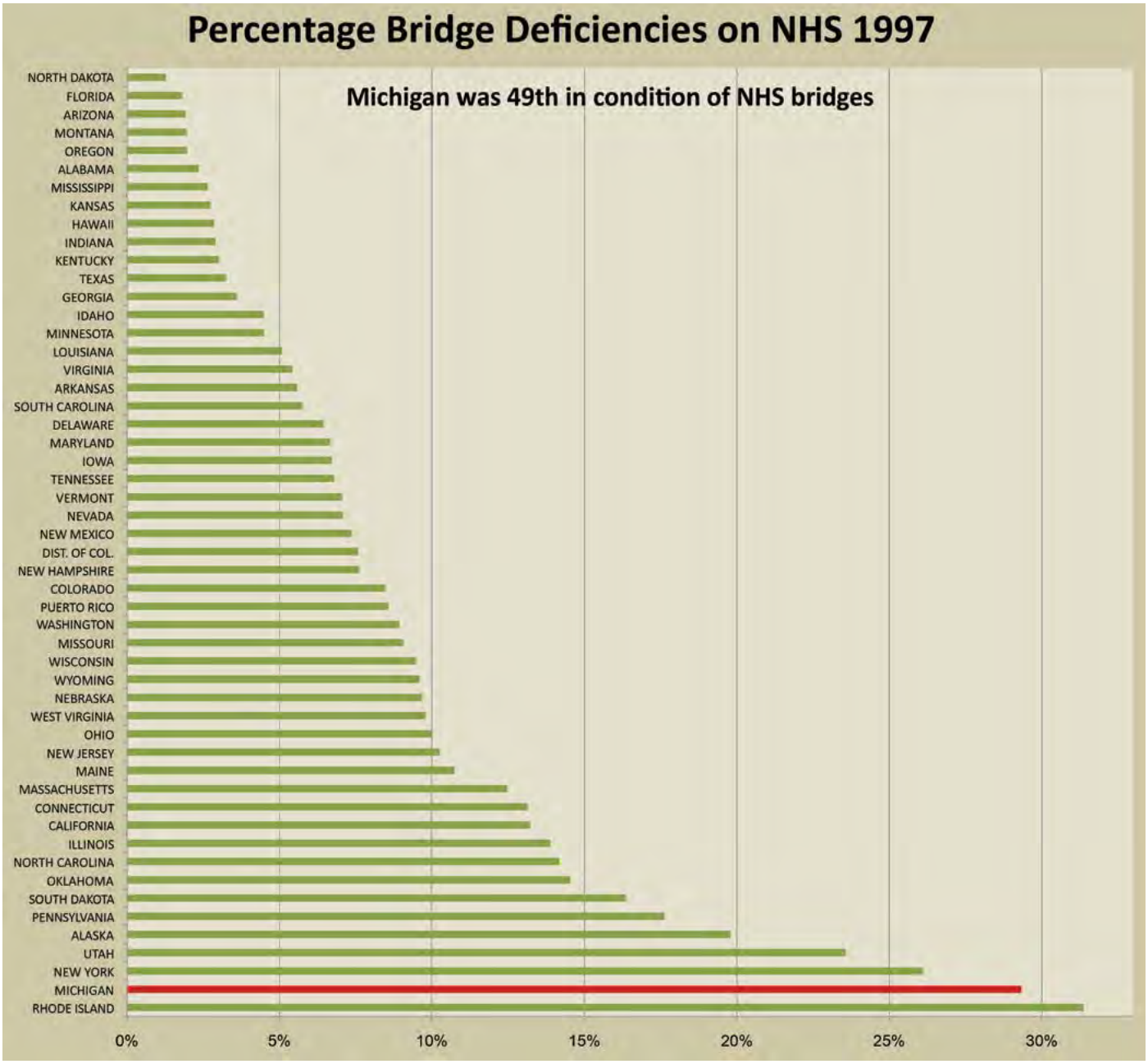


Figure 3. *In 1997, Michigan bridges were next to last nationally.*

they were disproportionately deteriorated. In terms of all bridges in Michigan in 1997, almost 23 percent were structurally deficient, almost twice the national average.

The Michigan DOT's pavements were also seriously deteriorated. Figure 4 portrays from 1998 the Michigan DOT lane miles of pavements in terms of the number of years of good service they could provide until they need resurfacing or major repair. This measure is known as remaining service life, or RSL. Basically, RSL indicates the number of years left in a pavement before it provides a very poor quality ride and requires a major expenditure to repair.

As can be seen, the largest category was the miles of pavement that had no years left of good service. Out of 27,330 total lane miles, 6041, or 22 percent, needed immediate repair. In fact, 40 percent of all the Michigan DOT lane miles had less than five years of service left in 1997. Figure 5 illustrates the broad distribution of these poor-condition miles across the state in 1998. Poor pavement conditions are more than just an annoyance. They lead to

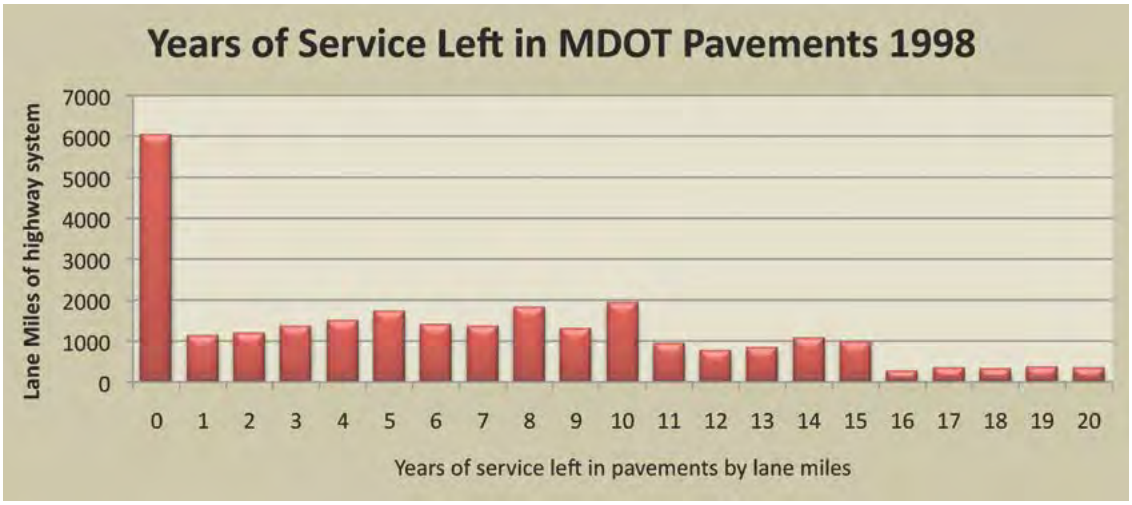


Figure 4. *6,000 lane miles needed immediate treatment in 1998.*

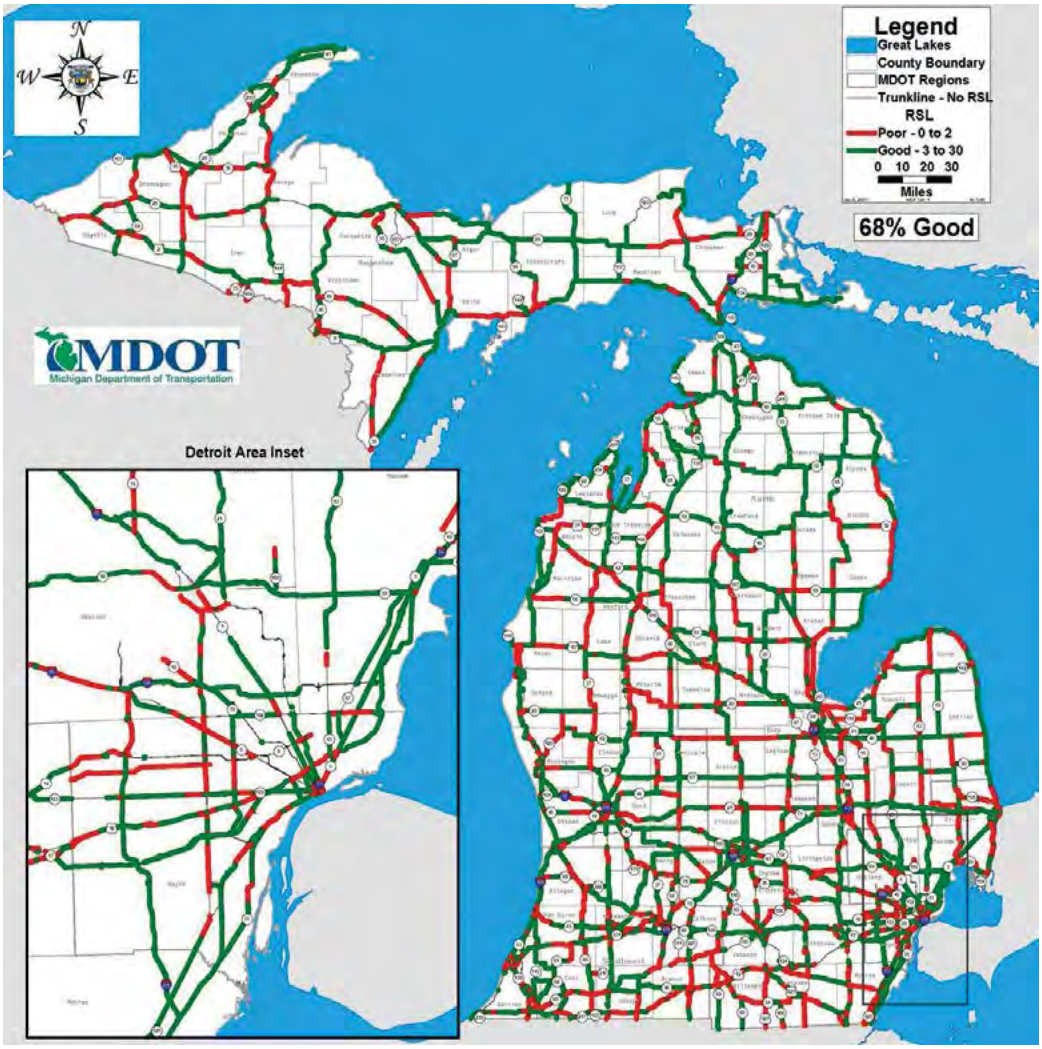


Figure 5. *In 1998, poor pavements were common in every region.*

higher crash rates caused by poor roadway friction that reduces stopping distances and increases run-off-the-road crashes. Poor pavements also decrease fuel economy, increase emissions and increase vehicle repair costs. In a 2012 study by the Transportation Road Information Program (TRIP), it was estimated that even on the better maintained Michigan roads of 2012, poor pavement cost Michigan residents $2.5 billion, or $357 dollars per resident. Those were the highest costs among the Great Lake states of Minnesota, Wisconsin, Illinois, Indiana and Ohio.

MDOT Progress Through Sound Asset Management

In part as a response to the poor state of MDOT's assets in 1997, MDOT embraced an improved approach to managing its roads and bridges. In the 2000's, MDOT became known nationally for the sound infrastructure management practices that it adopted to reverse the previous decline in asset conditions. The highway research division of the National Academies of Sciences in 2007 included a lengthy section on MDOT's infrastructure management practices in a report it produced on best practices on highway asset management.[5] The National Cooperative Highway Research Program (NCHRP) report cited MDOT (along with five other state transportation departments) for its good practices in improving, and then maintaining, its highway assets. Known as Transportation Asset Management, the practice involves not only repairing highway assets that are in poor condition but taking a lifecycle approach that ensures sustaining good conditions across the entire highway network for a long period, such as 20 years. The approach behind asset management is to create a sustainable highway network that provides long-term service to not only current users but also to future ones.

The NCHRP report praised MDOT for its holistic use of a "mix of fixes" at the right time in the lifecycle of each individual bridge, pavement, traffic signal, guardrail and even freeway-information-system component. Asset management emphasizes inventorying and inspecting assets continually to plan for the proper preventive treatment at the right time for each asset. It almost always is less expensive to preserve a highway asset with minor treatments than to allow the asset to severely deteriorate and then to rehabilitate or replace it. Sound asset management as practiced at MDOT involves understanding each phase of an asset's lifecycle and intervening at the appropriate times to prevent the need to replace assets for as long as economically possible. The opposite of sound transportation asset management is to build an asset and then ignore it until it deteriorates to the point of failure.

Many highway agencies were slow to embrace transportation asset management until the 1990s because for the previous 30 years their emphasis had been upon completing the Interstate Highway System. Their focus primarily was upon building new highways and they were less inclined as institutions to focus upon the long-term maintenance of their assets.

By the 1990s, many states were in the situation faced by MDOT. Their Interstate Highway System was not only complete but by that point much of it already was more than 30 years old. By the early 2000's, increased oil prices raised the cost of highway maintenance, caused motorists to shift to fuel-efficient cars which decreased fuel tax revenues and the declining economy created resistance to fuel-tax increases. Those factors combined to create the infrastructure funding crisis which nearly all states and the federal government are struggling with today. Michigan acted to increase transportation funding in 1997, not knowing that the transportation funding crisis, and the economic situation in general, was to become even more acute in the decades of the 2000s.

During this time, the Michigan DOT became particularly known for its efforts to preserve both its bridges and its pavements. In fact, the development of a national pavement preservation ethos was centered in Michigan. The pavement preservation approach is to continually monitor pavements and to use low cost treatments such as sealing cracks and using thin, inexpensive "chip seals" and other treatments to keep good pavements from deteriorating. MDOT's contribution to the national growth

in pavement preservation practices is reflected in the creation of the National Center for Pavement Preservation at Michigan State University. The pavement preservation practices and personnel at MDOT were so prominent that the national center was located in the state.

The state progress in pavement conditions can be seen in figure 6. While in 1997, more than 6000 lane miles of pavements needed immediate repair, by 2007 that had been reduced to 1638 lane miles or less than 6 percent of the highway network. The number of miles with less than five years of life were cut by more than half compared to just five years earlier as seen in figure 7.

Unfortunately, with the constrained budgets since 2007 and because of much higher construction prices, the amount of poor pavement is growing again. As displayed in Figure 7, the miles of pavements with fewer than five years of service life have crept upward to 24 percent by 2012. However, as shown in figure 6, the overall "health" of the MDOT pavement network is substantially better than in 1997. As depicted in Figure 6, the more miles to the right of the chart, the better. The green

Figure 6. *Michigan's pavements steadily improved from 1997 to 2007.*

Figure 7. *Roads needing immediate repair declined significantly.*

bars depicting 2012's pavement conditions illustrate that the years of life in the state's pavements have increased overall. This represents a more robust network of pavements that are in much better condition than in 1997 and provide smoother rides, lower costs and contribute to fewer crashes. Figure 8 shows composite maps of pavement conditions in 1998 at right and in 2009, the peak of pavement condition, below. The amount of deficient pavement shown in red are noticeably less in 2009.

MDOT also made substantial progress on its near-worst bridge conditions. The state DOT pioneered bridge preservation techniques, much as it did pavement preservation techniques. With a bridge preservation approach, the department takes early steps as shown in figures 9 and 10 to make many smaller repairs intended to prevent small bridge problems from becoming big ones. As seen in Figure 9, crews are removing a small section of damaged concrete from the bridge deck and repairing it before the distress spreads further. Such repairs reduce the corrosion of the reinforcing steel, they keep salt and water out of the concrete and greatly increase the lifespan of the bridge.

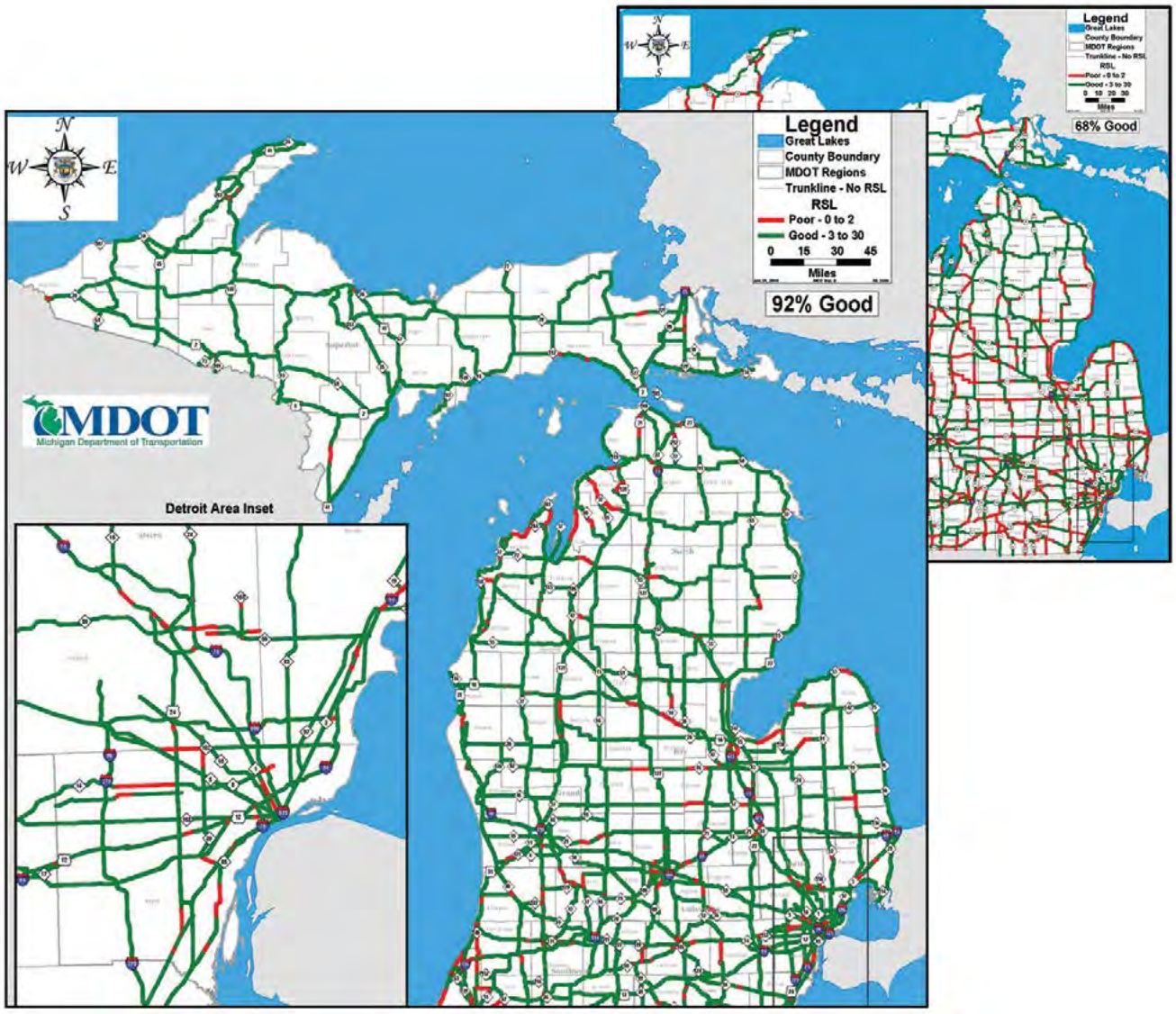


Figure 8. *MDOT 'got the red out' by 2009.*

Figure 9. *Crews repair a bridge deck.*

Such preservation reduces the long-term cost of bridge repairs but also provides the public with a better, smoother ride. In figure 10, crews are sealing the concrete on a bridge deck which keeps salt from infiltrating the concrete and rusting the reinforcing steel. These types of small repairs and preventive steps can save hundreds of millions of dollars over the course of a decade. Again, the strategy is to keep good assets in good shape through many small, timely repairs that prevent minor problems from becoming major ones. The MDOT bridge preservation approach was cited in two national reports of best practices.[6,7] As seen in Figure 11 (see next page), the MDOT strategies resulted in substantially improved bridge conditions. By 2011, it was within a fraction of a percentage of meeting the national average for bridge deficiencies on its National Highway System. Its overall bridge condition by 2011 was better than that of Indiana and Illinois.

Figure 10. *Crews seal a deck.*

As can be seen in figure 12 (see page 11), MDOT's rate of improvement in its bridge conditions far surpassed the rate of improvement nationally. Overall, bridge structural deficiencies on the National Highway System fell nationally between 1992 and 2011 but they fell much more substantially in Michigan. There had been approximately 1025 structurally deficient bridges on Michigan's National Highway System routes in 1997 and they were reduced to 670 by 2011. That represents more than one million square feet of deficient bridge deck area reduced between 1997 and 2011 on the NHS routes alone. Statewide, the number of structurally deficient bridges fell from 2213 to 1389.

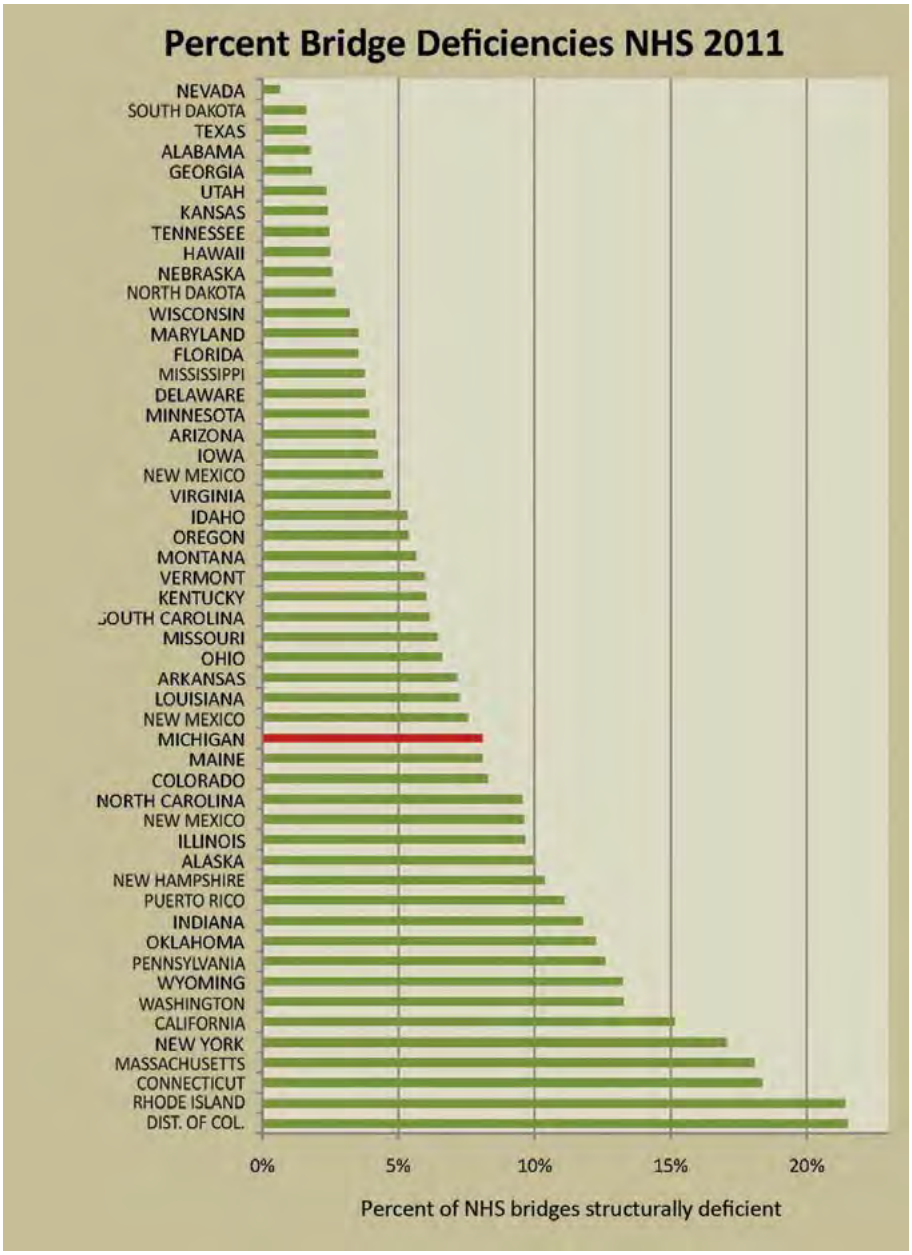


Figure 11. *Bridge conditions rose to near average.*

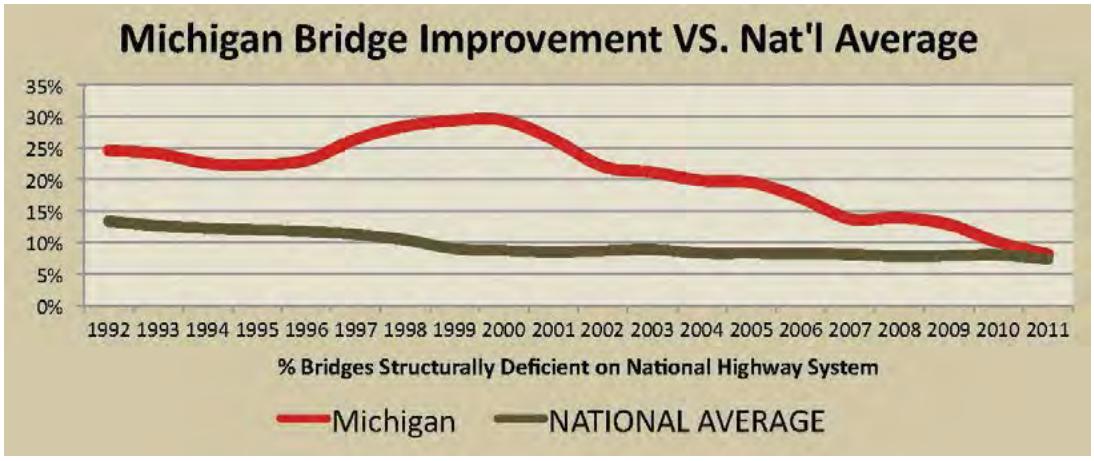


Figure 12. *Bridge improvement was well above national averages.*

Progress Was Not Funded by 1997's Fuel Tax Increase

This major improvement in highway conditions was only in small part paid for by the 1997 motor fuel tax increase. Instead, most of the proceeds of that increase went to local governments, debt service and routine maintenance as depicted in Figure 13. Over the 15-year period, the lack of sufficient revenue for pavement and bridge preservation prompted MDOT to fund those activities through bonding, increasing the department's debt service obligations and further reducing the portion of the 4-cent increase available for pavement and bridge preservation.

The green bar represents the total, cumulative proceeds from 1997-2012 of the 1997 four cent fuel tax increase of $2.85 billion. Of that, just under half, or $1.38 billion, went to MDOT under state law. The rest went to local governments. The yellow bar represents what was available for "capital" purposes such as paving, bridge repair or new construction after costs such as bond debt, routine maintenance, and other non-capital costs were covered. The small black and red bars indicate the amount of the four-cent increase that was available to help preserve MDOT's bridges and pavements.

The yellow bar's $444 million available for capital represents only about one-third of MDOT's proceeds from the four-cent increase over the 16-year period of 1997-2012. In other words, only half of the total increase went to MDOT, but only a third of that total was available for capital investment. And of those funds, only 57 percent was available to preserve bridges and pavements. The funds that did not go to capital went primarily to pay for bonds and to fund maintenance such as plowing snow, activities which are not eligible for federal funds.

Between 1997 and 2003, approximately 132 capacity-expansion or improvement projects were constructed for a total approximate cost of $990 million funded with state, federal and bond revenue. Many of these projects were part of the Build Michigan programs initiated to encourage economic growth. These projects were deemed critical to improve safety, alleviate congestion and to improve the state's economy. As the state's economy struggled with the auto industry's downturn through the 2000s, state leaders believed it to be essential for the state highway network to expand and improve to keep and attract jobs. The pressure to add highway capacity was both short-term and long-term. In the short-term, the new capacity projects created immediate construction and related jobs but they also demonstrated to current employers that Michigan would respond to their needs to keep transportation costs low and allow

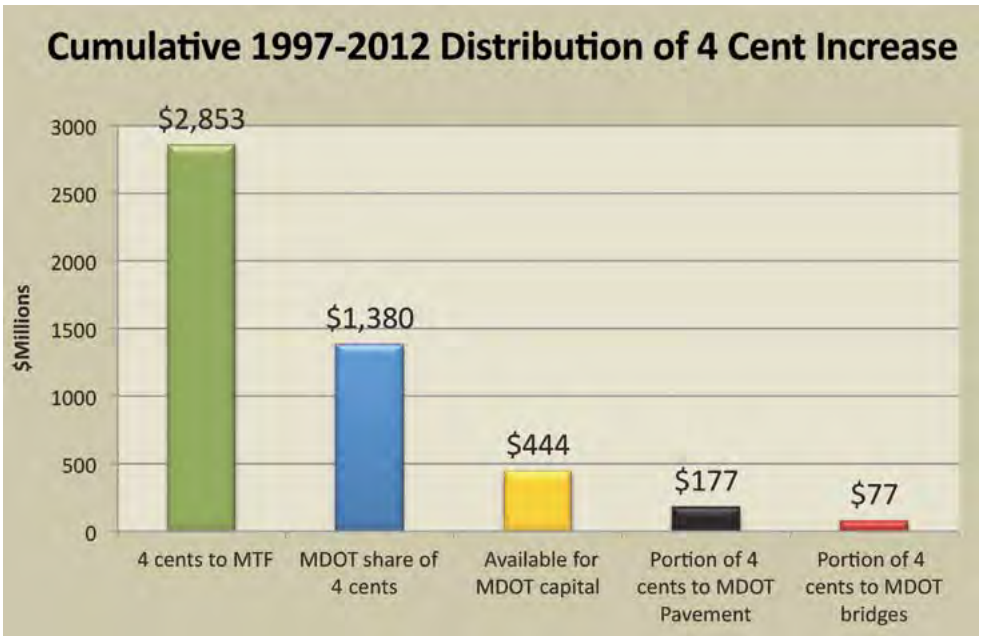


Figure 13. *A fraction of the increase went to pavements, bridges.*

them to compete globally. For the long-term, the capacity-expansion projects also indicated that the Michigan transportation network would be efficient and competitive for decades and, therefore, the state was a good location for new investment.

The use of the four-cent proceeds primarily for projects not related to bridge and pavement repair created a three-fold need for MDOT to borrow substantially to improve its lagging bridges and pavements. First, the poor state of its assets in 1997 would only grow worse if untreated and would cost even more to repair eventually if steps had not been taken immediately. Secondly, the depressed economy created strong incentives to increase highway investments to create and retain jobs. Third, to keep the state economically competitive, the existing trunklines had to be in passable condition.

From 1997 through 2000, the state relied exclusively on its state funds and federal reimbursements to pay for its pavement program. Beginning in 2001, however, it began to borrow to pay for its pavement program. As seen in Figure 14, the amount of the pavement budget that came from bond income or from the federal economic stimulus legislation known as the American Recovery and Reinvestment Act (ARRA) exceeded 40 percent in four separate years and once it exceeded 50 percent. Figure 15 breaks down by year the sources of the pavement program and highlights the non-sustainable ones. Bonds and ARRA are considered non-sustainable because the department has reached its financial limits to afford any additional debt. The ARRA funds were non-sustainable because they came from a one-time federal emergency rescue act.

Figure 16 illustrates that between 2001 and 2012 a total of 28 percent of the total MDOT paving program came from either one-time or borrowed sources of income.

The pressure to borrow was exacerbated between 2005 and approximately 2008 by an unprecedented increase in material prices. Prior to the real-estate and banking-driven downturn of 2008, the global economy was expanding, as was demand for oil. Global increases in oil consumption and rising modernization in China and India put global pressure on prices for asphalt, cement, steel and diesel fuel. Those key components of highway construction contributed to the substantial rise, and then fall, in construction prices as seen in Figure 17.

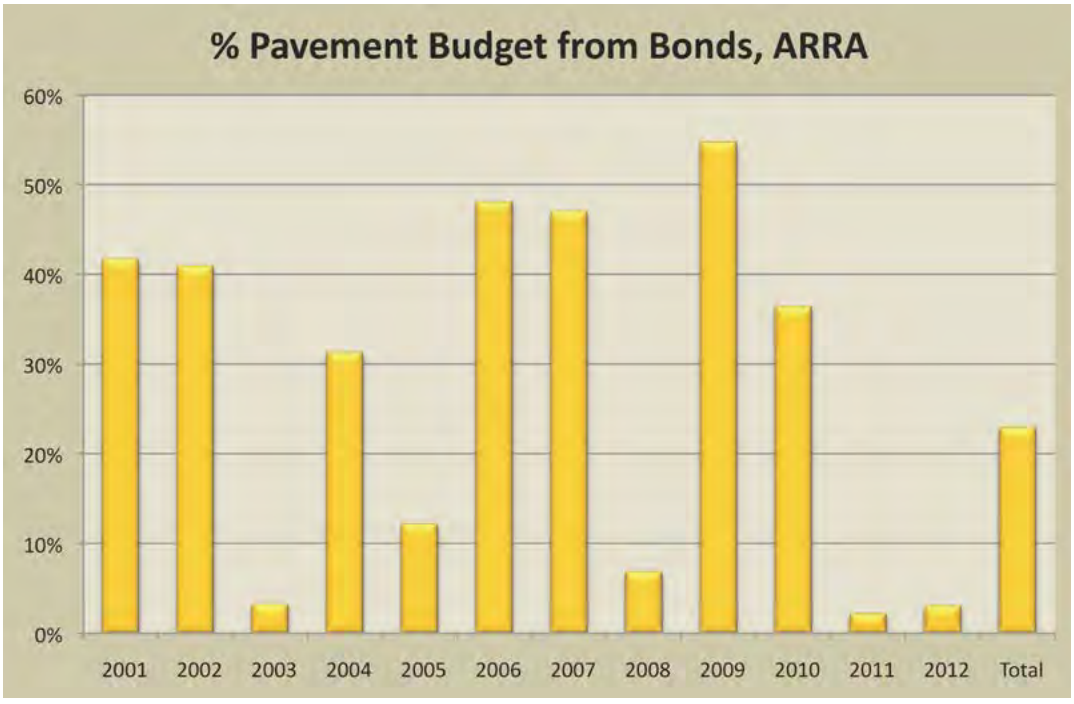


Figure 14. *MDOT had to rely on non-sustainable funding sources.*

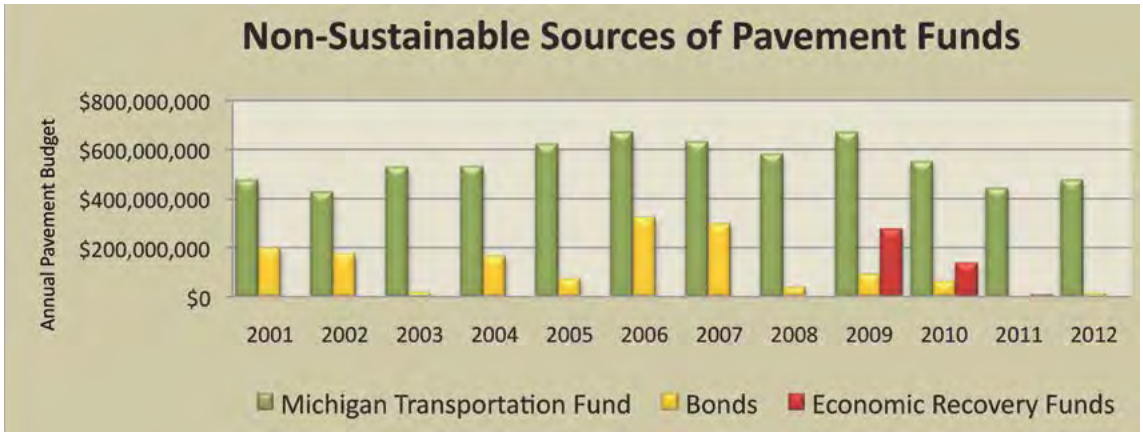


Figure 15. *Borrowing and economic stimulus income were essential.*

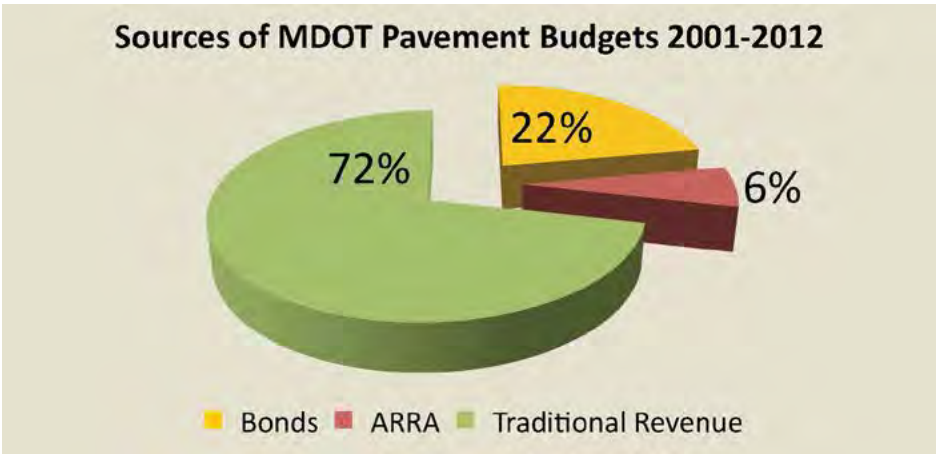


Figure 16. *Twenty-eight percent of pavement budgets came from unsustainable sources.*

Figure 17. *Construction inflation soared in the mid-2000s.*

Between 1997 and 2007, MDOT's construction prices had risen by approximately 55 percent. This substantial increase came just as the department was making progress on its bridge and pavement conditions. Then, after the 2008 economic crisis, pressure continued on the department to sustain its large highway construction program as an economic stimulus strategy. Prices did gradually decline to near-historic levels but only after a sustained period from 2006 through 2010 of unprecedented high construction material prices that eroded the department's purchasing power. The investment strategies from 1997 through 2012 left MDOT with significantly improved highway conditions but it also left a substantial amount of indebtedness. As seen in figure 18, the bond payments just for the $1.46 billion borrowed for bridge and pavement projects rose from $11 million in 2002 to just over $103 million for 2012. State Transportation Commission policy sets a cap for MDOT's bonded indebtedness. The department is now close to that cap and it is no longer possible to continue borrowing at the rate of the past. Total bond indebtedness, including bonds issued for system-expansion projects, now cost MDOT $220 million annually.

The result of an end to borrowing is a significant decrease in expected pavement budgets. As seen in Figure 19, the budgets of more than $600 million in 2009 will fall to less than $400 million by 2017 if current departmental income project ions remain unchanged. The effect of these declines are even greater than they appear in Figure 19 because of the effect of inflation, as shown in Figure 20.

When the effects of construction inflation are applied both to past pavement budgets as well as to projected future ones, it indicates that by 2017 pavement budgets when adjusted for inflation will be less than they were in 1997 when Michigan

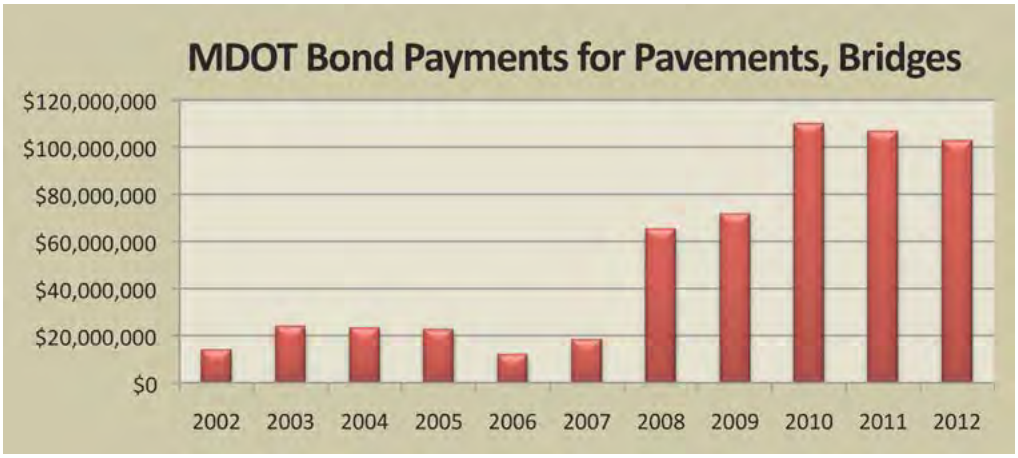


Figure 18. *Bond payments rose rapidly.*

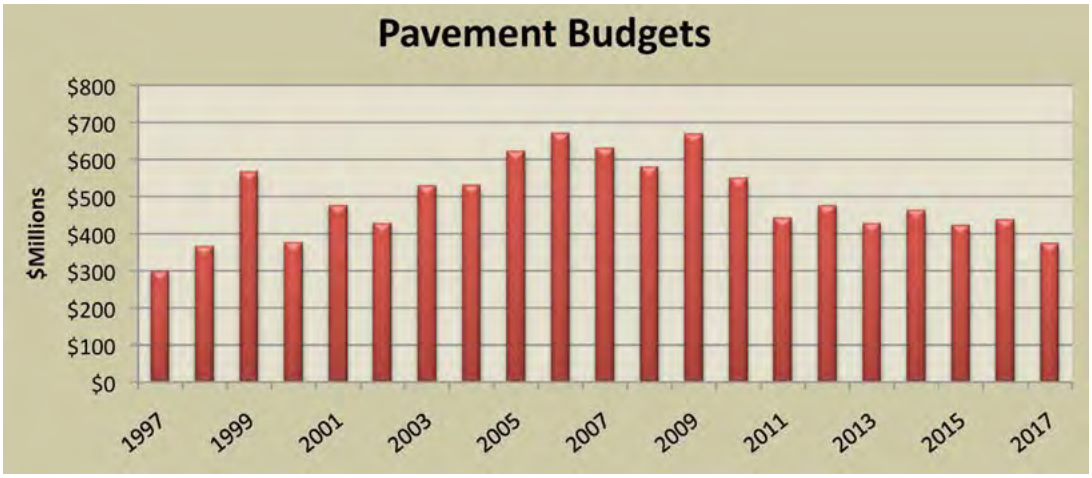


Figure 19. *Pavement budgets are declining.*

began its efforts to improve its highway infrastructure conditions as seen in Table 1. The department projects a pavement budget of $373 million in 2017. When the construction cost inflation factors are applied to that budget, by 2017 the department will have less pavement purchasing power than it had with its pavement budget in 1997.

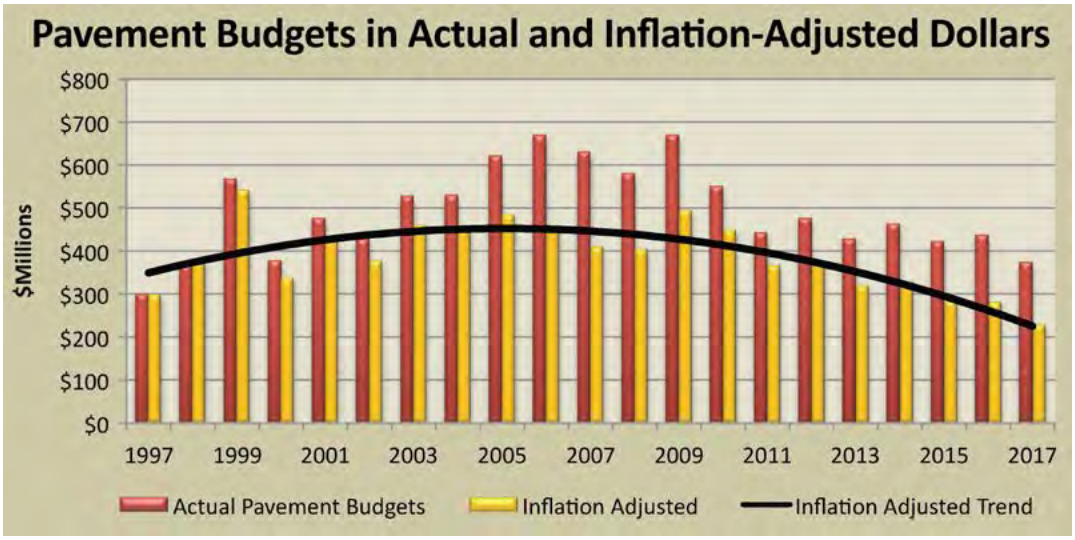


Figure 20. *Inflation-adjusted budgets are near 20-year lows.*

Table 1. *Actual and inflation-adjusted budgets.*

Year	Actual Pavement Budgets	Inflation-Adjusted Budgets
1997	$298	$298
1998	$365	$376
1999	$566	$541
2000	$376	$337
2001	$476	$429
2002	$427	$377
2003	$527	$460
2004	$530	$450
2005	$621	$484
2006	$669	$459
2007	$630	$409
2008	$580	$404
2009	$669	$494
2010	$550	$449
2011	$442	$366
2012	$475	$372
2013	$428	$318
2014	$463	$328
2015	$421	$285
2016	$436	$281
2017	$373	$228
(Millions)		

The Road Not Taken: The Needed Investment in 1997

The transportation consulting firm Spy Pond Partners recently conducted an analysis of how much investment would have been needed in 1997 for MDOT to achieve two important objectives: Meet its bridge and pavement condition targets and avoid expensive borrowing. This analysis was conducted to illustrate the consequences of past decisions and to help predict the impact of possible future options.

As is demonstrated by the facts above, the 1997 fuel tax increase was only a partial solution to the state's pressing bridge and pavement condition crisis. Most of the revenue went to local governments, routine maintenance, and debt service as opposed to improving basic highway and bridge infrastructure. The state now has significantly improved highway infrastructure but at the price of nearly $1.5 billion in bond indebtedness issued to preserve pavements and bridges that cost MDOT nearly $103 million in 2012 to finance. That, combined with other bond service, leaves the department unable to borrow more. Federal highway program funding is not expected to increase, but in any event the department has in the past few years struggled to have enough state income to match federal highway funds apportioned to the state, relying on toll credits and a one-time infusion of general funds to achieve the match.

The analysis began by revisiting the highway-condition targets the State Transportation Commission set for the department back in 1997 when the motor fuel taxes were last increased. Specifically, MDOT's targets were to bring 95 percent of its freeway pavements and bridges to good or fair condition, and 85 percent of its non-freeway pavements and bridges to good or fair condition.

These were ambitious goals given the department's poor highway and bridge conditions in 1997 but, if achieved, would have brought Michigan's roadways to at or above national condition averages.

Table 2 summarizes actual pavement and bridge conditions in 2007 and in 2012.

As can be seen with the color coding, in 2007 MDOT achieved its non-freeway pavement targets and nearly achieved its freeway pavement targets. By 2012, pavement conditions had slipped, with the condition of freeway pavements falling further below the target, while MDOT had met its targets for bridge conditions.

Note that the pavement conditions declined between 2007 and 2012 for freeway and non-

Table 2. *MDOT pavement and bridge conditions.*

Actual Conditions				
	2007		2012	
Description	Pavement	Bridge	Pavement	Bridge
% Good/Fair–Freeway	93%	88%	85%	95%
% Good/Fair–Nonfreeway	91%	89%	87%	94%
Targets				
	2007		2012	
Description	Pavement	Bridge	Pavement	Bridge
% Good/Fair–Freeway	95%	95%	95%	95%
% Good/Fair–Nonfreeway	85%	85%	85%	85%

freeway pavements. This indicates that even with the increased investment MDOT had made since 1997, the pavement investments since 2007 were not enough to sustain the good pavement conditions achieved then.

The analysis indicates that if MDOT were to have achieved its current highway conditions without resorting to borrowing nearly $1.5 billion, in 1997 it would have needed a nine-cent fuel tax increase instead of a four cent increase. That assumes that the proceeds would have been split with local governments as required by state law. That additional five cents would have resulted in approximately $1.7 billion in additional revenue to MDOT, not adjusted for inflation back to 1997.

To have met its condition targets in 2012, the department would have needed a total 14-cent per gallon fuel tax increase, or 10 cents per gallon more than actually enacted. This higher amount reflects the need for increased investment after 2007 to sustain pavement conditions. In other words, there are two analysis thresholds. To achieve current conditions without borrowing required a nine-cent increase in 1997. To achieve the department's condition targets without borrowing and sustain them until today would have required a 14-cent increase.

*In 1997, a **9-cent** per gallon fuel tax increase would have been needed to achieve MDOT's road and bridge condition targets on schedule without borrowing. A **14-cent** per gallon increase would have been needed to sustain those pavement and bridge conditions until today. Instead, the increase was **4-cents** per gallon.*

Forecasts of Declining Conditions

MDOT uses sophisticated computer models to estimate the amounts needed for bridges and pavements and to forecast future bridge and pavement conditions based upon different investment levels. These models are continuously reviewed with past forecasts and actual results to ensure they are reasonably accurate.
The department also forecasts its investment levels, which are relatively straightforward. The department has three major sources of revenue, state motor fuel taxes, state registration fees, and federal highway funds. The department can also issue bonds against those revenue sources. Because fuel consumption is predictable and has been for 30 years, the amount of state fuel tax income is relatively easy to predict. Likewise, state registration fees, based on the value of automobiles and weight of trucks, have been a reliable and predictable source of transportation revenue. In recent years, federal funds have been more uncertain because of Congressional uncertainty, but the general levels of federal funding overall are determined by the amount of federal fuel tax proceeds.

This predictability allows some certainty in forecasting that current federal funding levels are not likely to increase substantially without a substantial federal motor fuel tax increase. Such a federal fuel tax increase does not seem likely. As for bonds, the department has nearly reached a responsible level of indebtedness and significant additional bonding is unlikely.

The combination of fairly high levels of certainty in predicting both investment levels and pavement and bridge conditions allows MDOT to forecast future highway conditions based upon reasonable assumptions of income. Assumptions for income are declining and so are the assumptions for investments in bridges and pavements. Figures 19 and 20 summarize expected actual and inflation-adjusted pavement budgets.

Figure 21 (see next page) shows the expected pavement condition decline on the Michigan trunkline network, based on the current available pavement budgets, as modeled by MDOT. As can be seen, conditions are projected to decline rapidly and dramatically. The decline accelerates within a few years because pavements degrade geometrically once they reach a poor condition state. In such a degraded state, the pavements "stabilize" into a rough, continuously cracked and bumpy surface. The lack of investment creates other costs such as higher vehicle operating costs, lower fuel efficiency and frequently higher crash rates. The department

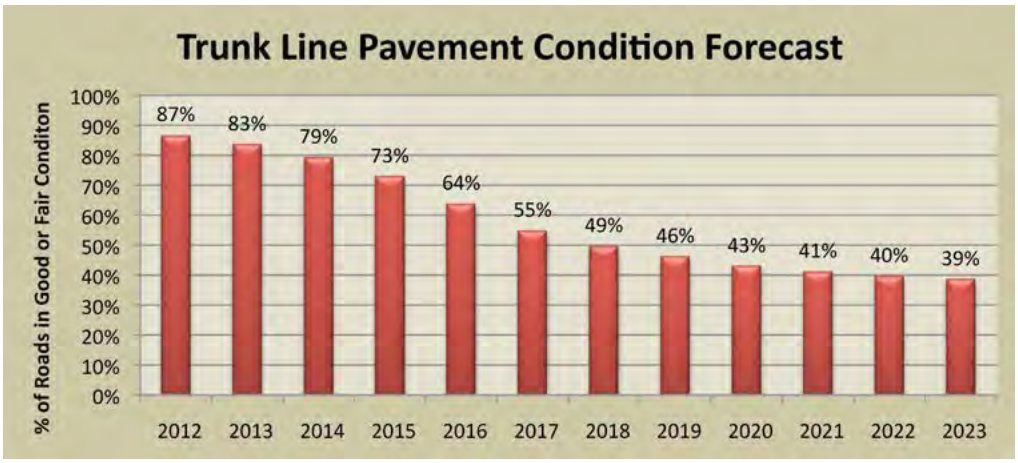


Figure 21. *Pavements are forecasted to decline rapidly.*

Figure 22. *Bridge conditions also are forecasted to decline.*

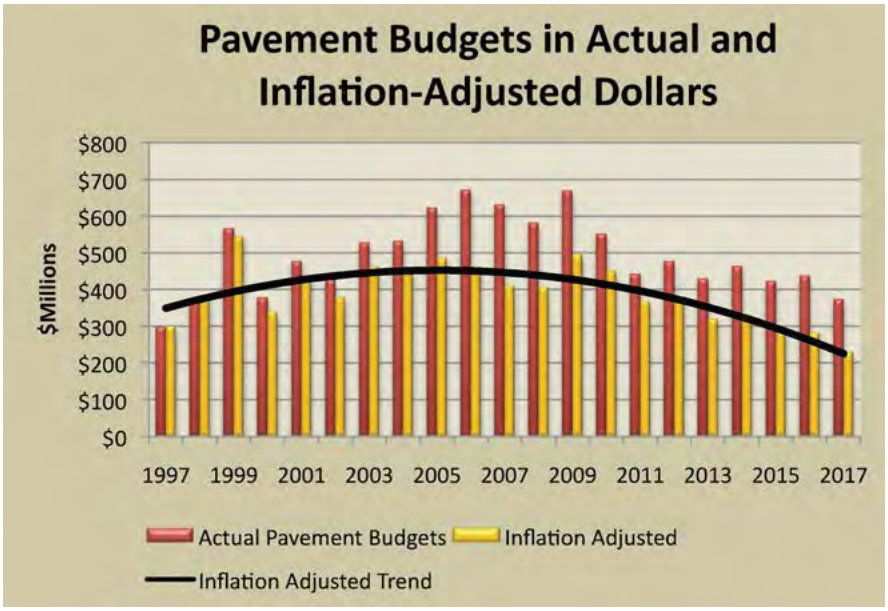


Figure 23. *Inflation-adjusted pavement budgets are lower than 1997's.*

also faces much higher costs to restore the poor pavements than to sustain the good ones.

Similar trends are forecast for bridges, as seen in Figure 22, although the rate of decline is not as steep. Bridges tend to degrade more slowly than pavements.

Nonetheless, based upon the bridge funding levels forecast in Table 3 and the condition forecasts in Figure 22, it is clear that the progress MDOT has made on its bridges is about to begin a long, steady reversal if funding remains as it currently is projected. As can be seen, in Figure 22, the bridge conditions are expected to decline and by about 2021, Michigan will again be below the national average for bridge conditions. As seen in Figure 23, when the future bridge budgets are adjusted for inflation, they will less by 2015 then they were in 1997.

Table 3. *Actual and inflation-adjusted bridge budgets.*

Year	Actual Bridge Budgets	Inflation-Adjusted Budgets
1997	$99	$99
1998	$148	$152
1999	$143	$137
2000	$196	$176
2001	$185	$167
2002	$201	$177
2003	$208	$181
2004	$194	$165
2005	$270	$210
2006	$209	$143
2007	$185	$120
2008	$191	$133
2009	$269	$199
2010	$218	$178
2011	$172	$142
2012	$246	$192
2013	$155	$116
2014	$160	$114
2015	$176	$119
2016	$150	$96
2017	$148	$91
(Millions)		

Lessons from the Past and Implications for the Future

In 1997, decision-makers in Michigan invested an additional four cents per gallon of motor fuel tax into the state's highway infrastructure. That amount was enough to build needed expansion projects but it only partially paid for the basic upkeep of the existing pavements and bridges that form the backbone of the state's highway network. To reverse the trends of declining conditions, the state transportation department relied upon bonding and one-time federal stimulus funds to steadily improve conditions since 1997. Since peaking in 2009, pavement conditions have begun to decline again because of inadequate investment, higher construction prices, aging infrastructure and increased traffic volumes. Today, the state is again considering an increased investment in its highway network at a time of declining infrastructure conditions, much as it did in 1997.

The analysis of the 16 years between 1997 and 2012 clearly reveal several important factors to be considered as decision-makers discuss future funding decisions:

- The significant improvements in Michigan's highway network are on the verge of reversal and the gains of the past are forecasted to be lost if additional investment is not forthcoming.
- Additional investment must address basic highway pavement and bridge needs in addition to any investment for new capacity.
- The need for investment is significant and any solution that does not fully address the demonstrated need will mean that current pavement and bridge conditions are likely to continue to decline, and decline more rapidly.
- Easy solutions such as additional borrowing or federal bailouts are unlikely.
- If additional investment to preserve highway pavements and bridges does not begin soon, the cost to address these needs will continue to escalate in the years to come.

Endnotes

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This report was written by Gordon Proctor & Associates, Inc. and the StarIsis Corp.
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Questions can be directed to:

Gordon Proctor | gordon@proctorassociates.com | (614) 313-6421

William Robert | Spy Pond Partners | wroberts@spypondpartners.com | (617) 395-4370

Polly Kent, Administrator | Intermodal Policy Division | Michigan Department of Transportation
kentp@michigan.gov | (517) 335-2905